Conclusion: The MC model of the linac revealed that CAX 10x10cm2 PDDs are not very sensitive to changes in the mean energy of the incident electron beam. However 40x40cm2 profiles reveal a high sensitivity to changes in the mean energy of the incident electron beam. The use of 10x10cm2 CAX PDDs to match the mean energy of the incident electron beam can result in undesired differences between measured and calculated 40x40cm2 profiles. However using 40x40cm2 profiles to match the mean energy of the incident electron beam can provide an overall better match to measurement of both PDDs and profiles.

EP-1602

Redefinition of the Electron beam treatment parameters for IORT applications

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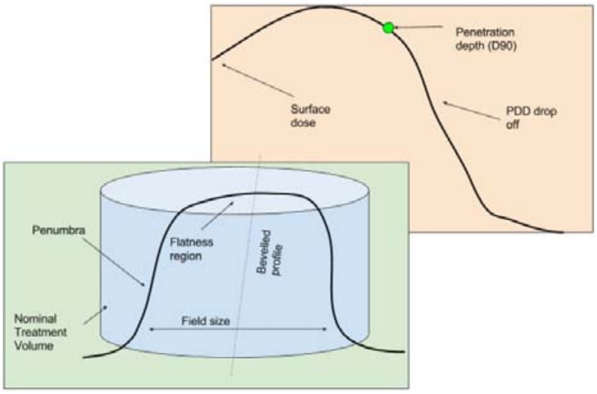
Purpose or Objective: The large number of conventional electron accelerators on the market (we estimate it around 5000) far exceeds the small, but growing number of mobile IORT linacs suitable for unshielded operating rooms. In this paper we discuss the technical aspects of the treatment beams produced by such small mobile IORT linacs. Beam parameter characterization for such machines need to be redefined in order to better reflect mobile IORT applications and provide basis for future technological development in the industry

Material and Methods: Using currently accepted industry standards, we compared the following electron treatment parameters of conventional and IORT linacs.
Treatment field size and shape
Penetration depth
Surface dose
Beam Penumbra and Flatness
Treatment on angular surface

Parameter	Conventional	Mobile
Treatment field size and shape	Standard field size is 10cm + and is constrained by the collimator and cutouts on the distal end of the applicator to form the treatment area.	Size of the field is less than 10 cm, often 4-6 cm diameter. Usually circular, but some oblong applicators are available
Treatment on angular surface	Soft bolus placed on the patient surface can compensate for inhomogeneous distribution of sloping surfaces	All IORT applicators have bevel ends of 0°, 15°, 30° and sometimes 45° to match anatomic planes. The larger the bevel, the greater the dose inhomogeneity across the field.
Penetration depth	Quantized with about 1 cm step (3 MeV equivalent)	Quantized with about 1 cm step (3 MeV equivalent)
Surface dose	There are attempts to reduce surface dose to spare the skin	Surface dose should be as close to 100% as possible to provide optimal treatment
Flatness	Beam is generally quite flat	Beam is generally less flat. Standard flatness definitions are often non-applicable
Penumbra of the beam	Treating at a 5 cm distance. Due to very good flatness inside the treatment area, penumbra of the beam only affects exposure of the healthy tissue outside the treatment field.	Treating in contact with the tissue. Metal applicators provide almost 100% protection of the tissue outside the applicator, and penumbra now affects cold spots inside the applicator

Table 1. Comparison of the critical beam characteristics for conventional linacs and mobile IORT linacs

Results: The following key beam parameters are either not controlled at all for IORT, or controlled in a way that is not very clear and effective. Flatness of the beam: Not well defined.For the applicators 6 cm and below current flatness definition produces no sensible beam characterization.
Penumbra: Not well defined. For beam sizes under 6 cm, the 1 cm wide penumbra might lead to as much as 30% of the treatment volume being either underexposed, or “not properly accounted for”
PDD drop off and Surface dose: Not controlled. PDD curve can change significantly as a function of field size and energy spectrum. An ideal monoenergetic beam has parameters which are not desirable in most IORT treatments.
Effective treatment volume: Not defined or controlled. Very critical parameter. Ratio of the treatment volume with delivered dose above treatment threshold (e.g. 90%) to the nominal treatment volume can be as low as 30% if cold sports are not properly accounted for.
Beveled applicator characteristics. Not defined or controlled. Procedures for testing of beveled applicators are very vaguely defined, and what definitions do exist are not very useful.



Conclusion: In order to properly redefine critical IORT beam parameters we present newly defined parameters such as controlled Flatness, PDD drop off, Surface dose and Effective treatment volume. When defined and controlled, these parameters will allow engineering teams to optimize the parameters of the treatment devices and provide the superior beam characteristics to improve treatment results.We also propose unified beveled and oblong applicator measurement protocol to summarize the knowledge currently present in the field.

EP-1603

Improved performance of the Varian TrueBeam Portal Dosimetry system for large fields

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Purpose or Objective: The performance of the Portal Dosimetry (PD) used for pre-treatment verification is affected by the beam profile correction used in the MV imager dosimetry calibration. This study evaluates a simple method to improve the performance of the TrueBeam PD system.

Material and Methods: A 40x40 cm2 diagonal profile measured at dmax is used as part of the imager calibration for the Portal Dosimetry software (PDIP). An over-response of the measured dose to predicted dose as the distance increases away from the central axis has been reported. Previous publications relating to the IDU20 panel have shown that manually modifying each point of the diagonal profile or applying software corrections can improve this off-axis effect. This method can be time consuming. A solution for the IDU20 panel with the Clinac model is available as part of the Varian Pre-Configured PDIP Package that utilizes an improved beam profile correction but is not currently available for the TrueBeam. The diagonal profile at d5 cm is almost identical with the profile at dmax up to about 10 cm and deviates downward as the distance increases. Using this profile for the calibration process could improve the off-axis areas of mismatch. The response of measured doses with predicted PDIP doses were evaluated in Varian TrueBeams equipped with either the IDU20 or the new DMI MV imaging panel. The PDIP algorithm was configured for use at 100 cm SDD following the manufacturer’s guidelines. Plans were created to compare the predicted with measured dose obtained by calibrating the imager at dmax and at d5 cm for 6X and 10X. Open fields and complex fluence patterns were compared to those predicted by the PDIP to evaluate the